

The Trouble with Crayfish

(Part of this lesson has been adapted from Project WILD's "Oh, Deer!" © Council for Environmental Education, 2002)

LESSON OVERVIEW

This lesson is designed for students to explore the natural fluctuations that take place within a healthy ecosystem, and to recognize how introducing a non-native species to that habitat can compromise the quality and diversity of the ecosystem. Students will be asked to compare a natural ecosystem before and after the introduction of crayfish. The students will then make recommendations for rules regarding responsible use of crayfish as classroom specimens.

SUGGESTED GRADE LEVELS

- 4

ENDURING UNDERSTANDINGS

- Ecosystems change over time due to natural and human events.
- Changes to one part of an ecosystem can affect all other parts of that ecosystem.
- Human activities can affect the potential for hazards.

OBJECTIVES

Students will:

- Identify and describe food, water, shelter, and space as four essential components of habitat.
- Describe the importance of good habitat for animals.
- Understand that animal population sizes will naturally change depending on the availability of food, shelter, water, and space.
- Explain the impact that introducing a non-native species can have on an ecosystem.
- Devise a plan to deal with the crayfish population in Arizona and present it to the Arizona Game and Fish Department.

ARIZONA DEPARTMENT OF EDUCATION STANDARDS

Grade	Science	Mathematics	Reading
4	S1-C3-01; S1-C4-02; S3-C1-01; S4-C3-03	S2-C1-02; S2-C1-03; S3-C4-01	S3-C4-01

Note: The full text of these standards can be found in Appendix A.

TIME FRAME

- 2 days (30 – 45 minutes each day)



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MATERIALS

- *The Crayfish Dilemma Response Sheet* (one per student)
- *Three Forks Stream A* (one per group)
- *Three Forks Stream B* (one per group)
- A large playing field (i.e., gymnasium or outdoor field)
- Masking tape
- Large butcher paper
- Markers

TEACHER PREPARATION

- Use the masking tape to mark two parallel lines on the playing field 10 – 20 yards apart. Chalk may also be used.
- Make copies of the *Crayfish Dilemma Response Sheet* for each student and the *Three Forks Stream A* and *Three Forks Stream B* for each group.

TEACHER BACKGROUND

Crayfish, also called crawdads, are not native to Arizona. They were introduced to Arizona's waterways in the 1940s as live bait. Since then, crayfish have become a problem to Arizona's natural habitats and native species. They are a particular problem for the riparian areas, where they have been released both accidentally and intentionally.

Crayfish are omnivorous, feeding on aquatic plants and animals, including lily pads, iris, insects, snails, tadpoles, frogs, baby turtles, fish eggs, fish, garter snakes, and even other crayfish. In Arizona, crayfish reduce the quality of the water by removing (eating) aquatic plants that filter and oxygenate it. With the plants gone, the soil is no longer held in place. When the crayfish feed and burrow, they stir up the gravel, rocks, and soil which increase the silt in the water. Crayfish may also out-compete other species in their use of available food and shelter.

It is against the law to release any organism (plant or animal) into Arizona waters without permission from the state. In addition, it is illegal to transport live crayfish throughout most of Arizona. You can legally harvest unlimited numbers of crayfish with a valid Arizona fishing license. (See actual rules and regulations at Arizona Game and Fish's website: azgfd.gov.) Being responsible scientists necessitates that students and teachers fully understand the ecological and legal constraints of following protocols for using and returning crayfish to the designated site, and not releasing them into the wild.

SUGGESTED PROCEDURES

Part 1:

1. Introduce the essential components of habitat with the students: food, water, shelter, and space in a suitable arrangement. This activity emphasizes three of those habitat components — food, shelter, and space. All fish need water to survive. For this activity, we are going to assume that the fish have adequate water.
2. Inform the students that they will be participating in an activity to simulate the effect that habitat has on the survival of an animal.



Photo © Philip J. Fernandez

*A brief look crayfish
in Arizona*



Photo © Philip J. Fernandez

3. Explain the rules of the activity:
 - a. Each person will represent food, shelter, space, or a fish looking for one of these habitat components.
 - b. If they are food (or a fish looking for food), they should rub their stomach as if they are hungry.
 - c. If they are shelter (or a fish looking for shelter), they should hold their hands together over their head like a tent.
 - d. If they are space (or a fish looking for space), they should hold their hands out at their side like they are grasping a Hula Hoop.
 - e. At the beginning of each round, they are allowed to choose what habitat component they wish to be or find. However, they are not allowed to change once the round has begun.
 - f. No running or horseplay.
4. Have students count off in fours.
5. The ones should line up along one line. The rest of the students should line up along the other line. Both groups should be facing away from each other, with their backs to the playing field.
6. When all the students have lined up, ask them to choose their habitat component and make the correct sign. Remind them that they are not allowed to change once the round begins, and they must make their sign throughout the entire length of the round.
7. Inform them that you will count to three. At that time, everyone should turn around and the activity will begin. The fish are the only ones that can move. Once they find their required habitat component, they should walk toward it. Each fish that reaches its necessary habitat component takes it back to the fish starting line because it has successfully survived the first round and been able to reproduce. Any fish that fails to find its food, shelter, or space dies and becomes a habitat component during the next round. If no fish needs a particular habitat component during a round, the habitat component just stays where it is for the next round.
8. Once the students are set, ask them to turn around and begin the activity.
9. After all the fish have either survived or died, the round is over.
10. Record the number of fish there were at the beginning and the end of the round.
11. Continue the activity for several rounds.
12. As a class or in small groups, have the students graph the data that was collected during class.
13. Discuss the results. What happened to the number of fish as the activity continued? Ask them to explain why they believe this could have happened. For example, the students may discover that the fish population increased for a few rounds before decreasing. This may be the result of less food (or shelter or space) available for all of the fish. Be sure to emphasize that this occurs naturally in ecosystems.
14. Inform the students that we will now take a look at what happens when we introduce a new species into an ecosystem.
15. Ask for a volunteer. This volunteer will represent one crayfish that was released into this ecosystem. You may wish to provide some background information on crayfish. In general, you should focus on the idea that crayfish are omnivores (they can eat just about anything) and they are not native to Arizona.

*A brief look at
crayfish in Arizona*

16. Return to the playing field.
17. Start the activity as before, with one group of students lined up along one line and all the rest along the other. This time, however, place the crayfish volunteer in a designated “den” just off to the side.
18. The rules for the fish and the habitat are the same. The crayfish must follow the following rules:
 - a. The crayfish hunts by tagging the other students.
 - b. During each round, the crayfish is allowed to tag one fish and one habitat component.
 - c. The crayfish can only move by skipping or hopping. (This will reduce the chance of a violent collision.)
 - d. Any student that is tagged by the crayfish becomes a crayfish in the next round.
 - e. Any crayfish that does not tag two students dies and becomes part of the habitat during the next round.
19. Start the activity again and repeat for numerous rounds.
20. Keep track of the number of fish and crayfish at the beginning and end of each round.
21. As a class, discuss the results of introducing crayfish into the game. Be sure to point out how quickly the crayfish population can grow and the destruction they cause to the habitat and the fish populations.

Part 2:

1. Divide the class into small groups.
2. Hand out the “Three Forks Stream A” picture to each group.
3. Ask them to look at the picture and record what they observe.
4. After about five or ten minutes, pass out the “Three Forks Stream B” picture.
5. Once again, ask them to look at the picture and record what they observe.
6. Inform the students that these photos were taken on the same day within a few feet of each other.
7. After a short discussion, inform students that the portion of the stream shown in Picture A is an area that did not have crayfish, while that shown in Picture B did have crayfish. The crayfish have destroyed most of the plants found in the stream and clouded the water.
8. Ask them to discuss the changes that they see in the pictures and attempt to explain why the stream may have changed.
9. Hand out a copy of *The Crayfish Dilemma Response Sheet* to each student. Depending on your preference, they may complete it in small groups or for homework.

ASSESSMENT

- Class discussion
- *The Crayfish Dilemma Response Sheet*

EXTENSIONS

- Write an essay about how we can be good stewards of our natural habitats and native wildlife.



Photo © Philip J. Fernandez

*A brief look crayfish
in Arizona*

- Pets are wonderful and give great benefit to their owners. What are the bad things that can happen when people decide that they don't want their pet any longer and decide to set it free? Create a flier for distribution at pet stores outlining the responsible options for "disowning" a pet. Or, write a persuasive paragraph/essay about not turning unwanted pets loose.
- Design a sign to be posted at fishing areas — Be responsible, don't dump your bait bucket.
- Crayfish are omnivores. Research the things they eat. What other omnivores live in Arizona's streams and wetlands?
- Research crayfish in their natural habitat. What part of the food chain do they fill in that ecosystem? What are their natural predators? Create a diagram of the food chain in this ecosystem. Contrast it with the diagram of an Arizona stream with crayfish.
- Arizona has a law prohibiting the transportation of live crayfish in most parts of the state. In groups or as individuals, have students assume the role of an angler, environmentalist or officer enforcing the law. Should this law be expanded? Maintained? Eliminated? Prepare a list of arguments to support your position. Conduct a two- or three-way debate in which each side gets to present their position.
- Are there other non-native species that you believe should be regulated? How would a new law be created? What could you do as an individual or a class to show your support or opposition to such a law?



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Appendix A: Arizona Department of Education Standards – Full Text

Science Standards

Grade	Strand	Concept	Performance Objective
4	1	3 – Analysis and Conclusions	1 – Analyze data obtained in a scientific investigation to identify trends
		4 – Communication	2 – Choose an appropriate graphic representation for collected data <ul style="list-style-type: none"> • bar graph • line graph • Venn diagram • model
	3	1 – Changes in Environments	1 – Describe how natural events and human activities have positive and negative impacts on environments (e.g., fire, floods, pollution, dams)
	4	3 – Organisms and Environments	3 – Analyze the effect that limited resources (e.g., natural gas, minerals) may have on an environment

Mathematics Standards

Grade	Strand	Concept	Performance Objective
4	2	1 – Data Analysis (Statistics)	2 – Construct a single-bar graph, line graph, or two-set Venn diagram with appropriate labels and title from organized data 3 – Interpret graphical representations and data displays including single-bar graphs, circle graphs, two-set Venn diagrams, and line graphs that display continuous data
	3	4 – Analysis of Change	1 – Identify the change in a variable over time (e.g., an object gets taller, colder, heavier)

Reading Standards

Grade	Strand	Concept	Performance Objective
4	3	4 – Persuasive	1 – Write persuasive text (e.g., advertisements, paragraph) that attempts to influence the reader



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Appendix B: Worksheets and Overheads

The pages that follow contain the worksheets listed below:

- A. *Three Forks Stream A* – A picture of an Arizona stream before crayfish were introduced (1 page)
- B. *Three Forks Stream B* – A picture of an Arizona stream after crayfish were introduced (1 page)
- C. *The Crayfish Dilemma Response Sheet* – A worksheet that allows students to write a persuasive paragraph about crayfish regulations (1 page)



Photo © Philip J. Fernandez

Three Forks Stream A

Look at this picture of a stream in Arizona. Record your observations in the space below.



Photo © Thomas R. Jones



Photo © Philip J. Fernandez

Three Forks Stream B

Look at this picture of a stream in Arizona. Record your observations in the space below.



Photo © Thomas R. Jones



Photo © Philip J. Fernandez

The Crayfish Dilemma Response Sheet

Crayfish are threatening what's left of Arizona's streams and wetlands. Crayfish are non-native, aquatic animals that don't fit into the complex, natural cycle of southwestern river systems. Crayfish will eat any organism they can catch and will strip a stream of its aquatic plants, turning a clear stream muddy. They reproduce quickly and have been released into natural riparian areas by well-meaning individuals, intentionally and accidentally.

You are on a committee formed by the Arizona Game and Fish Department with the task of coming up with a plan to help save Arizona's streams and wetlands from the threat of crayfish.

In the space below, brainstorm some possible solutions to this problem. Record your ideas below. Remember to write down why you think your solution is the best plan of action.

Based on your ideas above, write a paragraph in which you explain your plan of action. Remember: you must persuade the Arizona Game and Fish Department that this is the best solution.



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